A SIGNAL PROCESSING BOARD FOR GAMMA-RAY TRACKING DETECTORS*

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Digital electronics are an integral part of gamma-ray tracking detectors, such as Gretina, as one is required to sample the preamplifier signal from each segment during charge collection to identify the location and charge deposited by gamma rays scattering through the HPGe Crystal. To accomplish this task, we have developed a prototype 8-channel, VME-based, signal processing board which continually samples its inputs at a sampling rate of 100 MHz with a 12-bit dispersion. The board was also designed to meet the more general requirements for a signal processor board as specified by the Argonne workshop on digital electronics (2001) for low-energy nuclear physics experiments.

This board is differentiated from most commercial digitizers in that it emulates, in a single large FPGA, much of the functionality found in analog systems for Ge detectors. Segment energies are calculated on the board so that one can extract only the part of the trace which contains information relevant to signal decomposition, rather than the significantly longer trace required to recover proper energy resolution. This allows the board to operate at standard Ge rates (several kHz). Internal leading edge discriminators which can be used to trigger the board are also provided as ECL outputs, which can be combined with external logic to construct more complex triggers. Constant fraction times, pileup detection and windowing algorithms are also implemented on the board. A global timestamp mechanism, operating at the sampling rate, is provided to allow synchronization of several boards.

Several signal digitizers have been constructed and successfully used in source tests with clover detectors and in in-beam tests with the Greta prototype–2, 36-segment detector. The most recent revision of the board is shown below. Production has begun to fully instrument the 3-crystal Gretina module prototype with these digitizer boards to perform end-to-end detector testing.

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